

3 Education

3.1 Degreed Programs

Oct 2003 - May 2006	University of Cambridge: Industrial Control Systems Engineering Cambridge, UK <i>Thesis Title: Reconfigurability Measurement in Automated Manufacturing Systems</i> Doctor of Philosophy at the Distributed Information & Automation Laboratory within the Institute for Manufacturing, Engineering Department. Worked with Prof. Duncan McFarlane to research the planning, design, system integration, and evaluation of re-configurable & autonomous industrial automation systems.
Sep 2000 - Jun 2002	Massachusetts Institute of Technology: Mechanical Engineering Cambridge, MA <i>Thesis Title: Compensation of Incoherent Errors in the Precise Implementation of Effective Hamiltonians for Quantum Information Processing</i> Master of Science specializing in System Dynamics and Control. Worked with Prof. David Cory to develop high precision signals to control nuclear magnetic resonance equipment for quantum information processing applications.
Aug 1996 Jun 2000	Massachusetts Institute of Technology: Mechanical Engineering Cambridge, MA <i>Thesis Title: Tip-Sample Contact Lateral Forces in Tapping and Contact Mode Operation of the Atomic Force Microscope</i> Bachelor of Science in Mechanical Engineering specializing in System Dynamics and Control. Worked with Prof. Kamal Youcef-Toumi to develop and simulate a model of the dynamic behavior of the atomic force microscope in contact and tapping Mode. Minors: Economics, Political Science & Music Theory
Jan 2003 - Jun 2003	Universidad Complutense de Madrid Madrid, Spain Certificate in International Political Science, Economics & Arabic Philology studied in the Spanish language.
Oct 2002 - Jan 2003	Universidad Complutense de Madrid Madrid, Spain Diploma in Spanish Language and Culture at the Superior Level.

3. EDUCATION

3.2 Professional Development & Training

2018	National Effective Teaching Institute Interactive Teaching Workshop
2011	MIT ESD 939 Course: Smart Grids & Electric Energy Systems.
2011	University of Minnesota Power System Protection.
2011	Mathworks Training: Stateflow for Logic Driven System Modeling.
2011	Mathworks Training: Simulink for System & Algorithm Modeling.
2011	PJM-ISO Training on Demand Side Response.
2011	PJM-ISO Training on Market Operations.
2011	PJM-ISO Training Generation 101, 201, 301.
2011	PJM-ISO Training Transmission Operations 101.
2010	MIT ESD 865 Course: Modeling of Electric Power Systems
2008	Air Liquide Training on Power Cogeneration Facilities.
2008	Air Liquide Training on Hydrogen & Syngas Production Facilities
2008	Air Liquide Training on Project Management

4 Professional Experience

4.1 Academic Appointments

Sep 2015 - Present	Associate Professor of Engineering Thayer School of Engineering at Dartmouth College Lead the Laboratory for Intelligent Integrated Networks of Engineering Systems to a program of research that engineers integrated control, automation & IT systems in the application domain of intelligent multi-energy engineering systems. This encompasses smart power grids, energy-water nexus, electrified transportation, supply chain energy management, & interdependent smart city infrastructures.	Hanover, NH
Jul 2016 - Present	Adjunct Associate Professor of Computer Science Computer Science Department at Dartmouth College Advised four undergraduate researchers from the computer science department.	Hanover, NH
Jun 2015 - Present	Research Affiliate: MIT Mechanical Engineering Department Continued an intensive research program in the domain of smart power grids. Co-advised several MIT mechanical engineering students.	Cambridge, MA
Aug 2016 - Present	Research Affiliate: U. of Mass. Transportation Research Center Enhanced the UMTRC's capabilities on connected, automated, and electric vehicles.	Amherst, MA
Jun 2014 - May 2015	Visiting Scientist: MIT Mechanical Engineering Department Continued an intensive research program in the domain of smart power grids. Co-advised several MIT mechanical engineering students.	Cambridge, MA
July 2010 - Aug 2015	Assistant Professor of Engineering Systems & Management Masdar Institute of Science & Technology Lead the Laboratory for Intelligent Integrated Networks of Engineering Systems to a program of research that engineers integrated control, automation & IT systems in the application domains intelligent energy systems. This encompasses smart power grids, energy-water nexus, transportation-electrification & industrial energy management.	Abu Dhabi, UAE
July 2011 - May 2014	Research Affiliate: Massachusetts Institute of Technology Maintained an intensive research program in the domain of smart power grids. Lead a seamless 11-person collaboration distributed between Masdar Institute and MIT MRL.	Cambridge, MA
July 2010 - June 2011	Visiting Scholar: Massachusetts Institute of Technology Initiated multiple research collaborations in the field of power systems. Academically: MIT Mechatronics Research Laboratory (MRL), MIT Future of the Electricity Grid Study, IEEE Control Systems Society. Industrially: PJM-Independent System Operator	Cambridge, MA

4. PROFESSIONAL EXPERIENCE**4.2 Relevant Research & Development Experience**

June 2007 - May 2010	<p>Environment & Greenhouse Gases Specialist: Air Liquide Group Paris, FR</p> <p>Joined Air Liquide's internal worldwide technical consulting division for hydrogen production and electrical power cogeneration facilities: Large Industries Worldwide Industrial Management.</p> <p>Technical Management: Chairman of industrial workgroup composed of representatives from competitors. Lead and managed working groups to deliver environmental and energy efficiency best practice documents for hydrogen production and electrical power cogeneration facilities. Coordinated between design, operations, and corporate group entities to ensure that the Group's environmental policy & practice adheres to European regulations. Advised two master's students on waste water treatment and noise emissions.</p> <p>Design: Analyzed & implemented regulatory design requirements into group technical requirements for hydrogen production facilities. Assessed & highlighted the environmental impact of proprietary technologies & design decisions in new projects.</p> <p>Operations: Implemented environmental best practice for steam methane reformers. Coordinated alarm management program across the R&D, E&C and operations business units.</p> <p>Lobbying: Became lead technical lobbyist for Air Liquide on the EU CO₂ Emissions Trading Scheme on Hydrogen Production and Air Separation Facilities. Influenced the clarity & simplicity of two European directive revisions. Evaluated & proposed best available techniques to 2 European technical working groups.</p> <p>Permitting: Facilitated European permits for steam methane reformers.</p>
Oct 2003 - Oct 2006	<p>Program Manager: U. of Cambridge Institute for Manufacturing Cambridge, MA</p> <p>Managed research relationship with Rockwell Automation 10,000E/yr and with EU Innovative Production Machines and Systems Research Network 60,000E/yr.</p> <p>Rockwell Automation: Ensured the timely delivery and installation of controllers. As research liaison, addressed current and future Rockwell enquiries. Submitted proposals for an expanded research relationship.</p> <p>I*PROMS: Ensured timely submission of deliverables and improved participation of research group. Developed successful proposals for further funding. Contributed to an extensive road mapping on the future of European Manufacturing. Conceived and organized academic/industrial workshop on reconfigurable manufacturing systems.</p>
Jun 2002 - Aug 2002	<p>Electricity Market Analyst: Air Liquide group Paris, FR</p> <p>Analyzed trends in the newly deregulated French electric energy market. Developed an IT application that improved forecasted market demand and price by 40% Presented the application and model to clients for their purchase and further investment.</p>
Jun 2002 - Oct 2002	<p>Algorithms Developer: Air Force Research Laboratory Lexington, MA</p> <p>Developed a set of similar point-target detection digital image processing algorithms to be used on simulated and real-life hyper-spectral imaging data sets. Also developed a set of quality metrics based upon probabilities of targets and false-detections. Conducted a matrix of statistical analysis tests comparing performance of the algorithms.</p>
Jun 2000 -	<p>Controls Engineer: Teradyne Industrial Consumer Division Boston, MA</p>

4. PROFESSIONAL EXPERIENCE

Aug 2000	Tested and Analyzed the dynamic response of a six degree of freedom Tiger robotic manipulator using Matlab and Labview. Performed statistical analysis on data and showed that prototype met design specifications. Developed a six-degree of freedom dynamic model of a four piston pneumatic manipulator. Cooperated closely with technicians, engineers and management to complete project.
Jun 1999 - Aug 1999	Controls Engineer: Cummins Engines Advanced Engineering Columbus, IN On a C/Simulink/Matlab platform, Designed, Simulated, Implemented, Tested, and Analyzed a control algorithm that will find optimal running conditions of fuel efficiency on 8.3L Natural Gas engine. Used Matlab and Simulink for simulation, and used Labview as instrumentation. Tested and analyzed a controller that controls the combustion process. Performed thermal-fluidic analysis on sensor failure and engine transient response. Developed a Simulink model of a port-injection engine.

4.3 Entrepreneurial Experience

Jan 2013 - Present	CEO & Founder: Engineering Systems Analytics LLC Mansfield, CT A engineering consultancy startup that applies control, automation, big data analytics solutions to the domains of smart power grids, water distribution, transportation, manufacturing, and sustainable health. Licensed the EPECS Simulator to ISO New England as wholesale electricity market operator. Served on the Advisory Board of another Clean Tech startup.
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4.4 Major New Computational Research Products

The Hetero-functional Graph Theory Toolbox: Given the increasingly central role of Hetero-functional Graph Theory to every research theme in the LIINES, we have developed this toolbox to standardize the process of data collection and structural analyses. This toolbox produces all of the analyses that are part of our recent hetero-functional graph theory book. We made this toolbox openly available.

EPECS – Electric Power Enterprise Control System Simulator: Developed a time domain simulator which integrates physical power grid dynamics with three layers of the power grid enterprise control including regulation, balancing operations, the real-time market and the day ahead market as is commonly implemented in American independent system operators. Recent extensions include full support for renewable energy, energy storage, and demand side resources.

RIGS – Resilient Intelligent Grid Simulator: Developed a time domain simulator which incorporates heterogeneous dynamics models of power system devices and allows for rapid reconfiguration of power grid topology, control structure, and control set points.

MATSUMO – Matlab Simulator for Urban Mobility Electrification: Developed a time domain multi-modal microscopic transportation simulator. Full support is given to electric vehicles. It uses the latest techniques in parallel computing and sparse-matrix based computation. The user can choose between discrete-event and hybrid system dynamics as well as several models of vehicle dynamics. The simulator can also be coupled to both the EPECS as well as the RIGS.

5 Research

5.1 Publications, Written Works & Presentations

Summary

Books: [5, 4, 3, 2, 1]

Book Chapters: [11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1]

Refereed Journal Papers: [45, 44, 43, 42, 41, 40, 39, 38, 37, 36, 35, 34, 33, 32, 31, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1]

Journal Papers Under Review: [7, 6, 5, 4, 3, 2, 1]

Refereed Conference Papers: [76, 75, 74, 73, 72, 71, 70, 69, 68, 67, 66, 65, 64, 63, 62, 61, 60, 59, 58, 57, 56, 55, 54, 53, 52, 51, 50, 49, 48, 47, 46, 45, 44, 43, 42, 41, 40, 39, 38, 37, 36, 35, 34, 33, 32, 31, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1]

Published Technical Standards: [2, 1]

Invited Articles & Op-Eds: [8, 7, 6, 5, 4, 3, 2, 1]

Invited Keynote Lectures: [6, 5, 4, 3, 2, 1]

Invited Industrial Seminars, Lectures & Presentations: [68, 67, 66, 65, 64, 63, 62, 61, 60, 59, 58, 57, 56, 55, 54, 53, 52, 51, 50, 49, 48, 47, 46, 45, 44, 43, 42, 41, 40, 39, 38, 37, 36, 35, 34, 33, 32, 31, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1]

Invited Academic Seminars, Lectures, & Presentations: [60, 59, 58, 57, 56, 55, 54, 53, 52, 51, 50, 49, 48, 47, 46, 45, 44, 43, 42, 41, 40, 39, 38, 37, 36, 35, 34, 33, 32, 31, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1]

Theses: [3, 2, 1]

Technical Reports & White Papers: [10, 9, 8, 7, 6, 5, 4, 3, 2, 1]

Internal Memoranda & Progress Reports: [16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1]

Workshop Presentations: [52, 51, 50, 49, 48, 47, 46, 45, 44, 43, 42, 41, 40, 39, 38, 37, 36, 35, 34, 33, 32, 31, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1]

Research Posters: [5, 4, 3, 2, 1]

Students for which Prof. Amro M. Farid was the advisor or co-advisor are highlighted in forest green. Prof. Farid's role in the publication is highlighted in blue.

Book

- [5] S. O. Muhanji, A. E. Flint, and A. M. Farid, *eloT: The Development of the Energy Internet of Things in Energy Infrastructure*. Berlin, Heidelberg: Springer (in press), 2018.
- [4] W. C. Schoonenberg, I. S. Khayal, and A. M. Farid, *A Hetero-functional Graph Theory for Modeling Interdependent Smart City Infrastructure*. Berlin, Heidelberg: Springer, 2018. [Online]. Available: <http://dx.doi.org/10.1007/978-3-319-99301-0>
- [3] A. M. Farid and N. P. Suh, *Axiomatic Design in Large Systems: Complex Products, Buildings and Manufacturing Systems*. Berlin, Heidelberg: Springer, 2016. [Online]. Available: <http://dx.doi.org/10.1007/978-3-319-32388-6>
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Book Chapters

- [11] A. M. Schoonenberg, Wester C.H. and Farid, "Evaluating engineering system interventions," in *Handbook of Engineering System Design*. Berlin, Heidelberg: Springer, 2020, pp. 1–20.
- [10] G.-J. Park and A. M. Farid, "Design of large engineering systems (in press)," in *Design Engineering and Science*. Berlin, Heidelberg: Springer, 2019, pp. 1–20.
- [9] I. S. Khayal and A. M. Farid, "Healthcare system design (in press)," in *Design Engineering and Science*. Berlin, Heidelberg: Springer, 2019, pp. 1–14.
- [8] S. O. Muhanji, A. Muzhikyan, and A. M. Farid, "Long-term challenges for future electricity markets with distributed energy resources," in *Smart Grid Control: An Overview and Research Opportunities*, J. Stoustrup, A. M. Annaswamy, A. Chakraborty, and Z. Qu, Eds. Berlin, Heidelberg: Springer, 2017, pp. 59–81. [Online]. Available: <http://dx.doi.org/10.1007/978-3-319-98310-3>
- [7] L. R. Gilbert III, M. A. Omar, and A. M. Farid, "An application of quality function deployment and axiomatic design to the conceptual design of temporary housing," in *Axiomatic Design in Large Systems: Complex Products, Buildings & Manufacturing Systems*, A. M. Farid and N. P. Suh, Eds. Berlin, Heidelberg: Springer, 2016, ch. 8, pp. 216–240. [Online]. Available: http://dx.doi.org/10.1007/978-3-319-32388-6_8

- [6] A. M. Farid, "An engineering systems introduction to axiomatic design," in *Axiomatic Design in Large Systems: Complex Products, Buildings & Manufacturing Systems*, A. M. Farid and N. P. Suh, Eds. Berlin, Heidelberg: Springer, 2016, ch. 1, pp. 1–47. [Online]. Available: <http://dx.doi.org/10.1007/978-3-319-32388-6>
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- [3] A. M. Farid, "Evolution of Electricity Grid," in *Wind Energy 2050: On the Shape of near 100% RE grid*. Bonn, Germany: World Wind Energy Association, 2015, ch. 5, pp. 45–48. [Online]. Available: <http://amfarid.scripts.mit.edu/resources/Books/SPG-BC03.pdf>
- [2] W. N. Lubega and A. M. Farid, "An engineering systems model for the quantitative analysis of the energy-water nexus," in *Complex Systems Design & Management*. Paris, France: Springer Berlin Heidelberg, 2013, ch. 16, pp. 219–231. [Online]. Available: http://dx.doi.org/10.1007/978-3-319-02812-5_16
- [1] S. Rivera, A. M. Farid, and K. Youcef-Toumi, "Chapter 15 - a multi-agent system coordination approach for resilient self-healing operations in multiple microgrids," in *Industrial Agents*, P. L. Karnouskos, Ed. Boston: Morgan Kaufmann, 2015, pp. 269 – 285. [Online]. Available: <http://amfarid.scripts.mit.edu/resources/Books/SPG-BC01.pdf>

Refereed Journal Papers

- [45] A. M. Farid, "Testimony of Dr. Amro M. Farid to the State of New Hampshire House of Representative," *HB315: Relative to the aggregation of electric customers*, p. 16, 2021.
- [44] S. O. Muhanji, C. Barrows, J. Macknick, and A. M. Farid, "An Enterprise Control Assessment Case Study of the Energy-Water Nexus for the ISO New England System," *Renewable and Sustainable Energy Reports*, vol. 141, pp. 110 766–110 785, 2021. [Online]. Available: <https://arxiv.org/abs/1908.10490>
- [43] A. M. Farid, "Testimony of Dr. Amro M. Farid to the State of New Hampshire Before the Public Utilities Commission," *DE 19-197: Electric and Natural Gas Utilities Development of a Statewide, Multi-use Online Energy Data Platform*, vol. 1, no. 1, p. 38, 2020.
- [42] A. M. Farid, M. Alshareef, P. S. Badhesha, C. Boccaletti, N. A. A. Cacho, C.-I. Carlier, A. Corriveau, I. Khayal, B. Liner, J. S. Martins, F. Rahimi, R. Rossetti, W. C. Schoonenberg, A. Stillwell, and Y. Wang, "Smart City Drivers and Challenges in Urban Mobility, Healthcare and Interdependent Infrastructure Systems Systems," *IEEE Potentials (in press)*, vol. 1, no. 1, p. 12, 2020.
- [41] A. M. Farid, M. Alshareef, P. S. Badhesha, C. Boccaletti, N. A. A. Cacho, C.-I. Carlier, A. Corriveau, I. Khayal, B. Liner, J. S. Martins, F. Rahimi, R. Rossetti, W. C. Schoonenberg, A. Stillwell, and Y. Wang, "Smart City Drivers and Challenges in Energy and Water Systems," *IEEE Potentials (in press)*, vol. 1, no. 1, p. 9, 2020.

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 - [38] S. O. Muhanji, W. C. Schoonenberg, and A. M. Farid, "Transforming the Grid's Architecture – Enterprise Control - the Energy Internet of Things and Heterofunctional Graph Theory," *IEEE Power and Energy Magazine*, vol. 17, no. 5, pp. 71–81, 2019. [Online]. Available: <http://dx.doi.org/10.1109/MPE.2019.2921744>
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